the general public will be perfectly logical in concluding that either the public analysts are generally incompetent, or that chemical analysis is self-contradictory, and therefore worthless. The subject is one that seriously affects the dignity and general interests of science.

Much of the blundering that has unquestionably occurred is doubtless due to the peculiar position of public analysts and the impossibilities they are called upon to perform. The political economist tells us that "demand for commodities induces a corresponding supply," and the Adulteration Act was evidently framed upon the assumption that analytical skill is a "commodity" subject to this law, as it demanded the immediate creation of a whole army of chemists endowed with a peculiar kind of knowledge and skill, which was not to be acquired in any college, school, university, or other educational institution, public or private, in Great Britain. Laboratories existed wherein the analyses of acids, bases, and salts, organic and inorganic, were carefully taught, and others where special attention was devoted to pharmaceutical preparations; but where (before the passing of this Act) could a student find a laboratory in which he might learn how to analyse the multitude of articles that pass over a grocer's counter, and acquire the *commercial* knowledge which is as necessary to the public analyst as analytical skill? I use the past tense here, knowing that since the passing of the Act many public analysts have industriously and meritoriously availed themselves of the opportunities afforded at one laboratory that has been specially devoted to the useful purpose of affording them the special analytical skill they should have possessed before obtaining their appointments. There do not, however, appear to be any sufficient means provided for the commercial and technological education of public analysts.

As an example of the necessity of commercial or technical knowledge, I need only refer to the discoveries of "iron filings" in tea which were so common until lately, the absurdity of which I have already demonstrated by simply calculating the number of tons of iron filings that would be annually required for the alleged adulteration, and showing the practical impossibility of obtaining such a supply, either here or in China. Iron was found in the tea unquestionably,—the chemistry was not at fault,—but the theory which confounded accidental impurity with wilful adulteration arose from lack of technical knowledge, the possession of which would have shown that leaves carelessly gathered and thrown upon the dusty ground of a highly ferruginous soil, and then roasted, must of necessity be mingled with more or less of magnetic oxide of iron, besides the iron naturally contained in the ashes of this particular plant.

The series of butter cases, of which the one you quote is only a recent and ordinary example, illustrate the same want of trade knowledge on the part of nearly all concerned. I have been surprised at the repeated and uncontradicted assumption that butter must be adulterated because it is cheap, which has run through all these cases. We all know that good butter at this season is not obtainable at less than 1*s*. 8*d*. per lb., and much is sold at 2*s*., and therefore it is inferred that if butter is offered for sale at 10*d*. or 1*s*. it must be adulterated. This is a very plausible inference, but nevertheless a great mistake, which public analysts and sitting magistrates have evidently shared with the general public. But for irritating old sores, I might quote from early prosecutions, and show how an inspector and public analyst have evidently been so biassed and deceived by the simple fact that butter was offered for sale at 8*d*. per lb., and that the analyst interpreted equivocal analytical results according to such preconceptions. Had he known that parcels of *genuine* butter, sometimes amounting to several tons, are occasionally offered as low as 7*d*. per lb. in wholesale markets, this erroneous preconception would not have been formed. I have eaten butter made in some of the primitive peasant-dairies of the North of Europe, which if imported to this country would not sell at so good a price as "P. Y. C." (Petersburgh yellow candle) tallow. It was perfectly genuine and detestably nauseous, but nevertheless was highly relished by the people who made it, and to whom it forms a staple article of food, especially in winter. Such butter is occasionally shipped to England from Kiel and other Northern ports; also from Canada and Australia, and sells at ruinous prices; the merchants who send it being unacquainted with the fastidiousness of English palates, and supposing that what is eaten in their own country will be eaten here.

It is the choice brands of "fresh" butter that are the most adulterated, and those delicately-constituted people who cannot eat salt butter, but insist upon having fresh grass butter in the midst of winter when no grass is growing, are abundantly regaled with refined mutton suet, P. Y. C. tallow, candle ends, and kitchen stuff which, when skilfully prepared, churned up with a little milk and sugar and prettily rolled, moulded or packed in rustic-looking baskets, sells at 2*s*. per lb. in the west-end, and progressively down to 1*s*. 8*d*. or 1*s*. 6*d*, proceeding further eastward.

Knowing that this class of butter is systematically adulterated at this season with refined fats, you may judge of my respect for the skill of the public analysts when I find that it has escaped the prosecutions that have fallen so heavily upon the cheap butters. Taking the facts as they have come out in these prosecutions, it appears that *at present* chemical analysis fails to distinguish between the fat which is excreted from the udder of the cow, and that which is deposited in the tissues of the same animal or of the sheep, provided both are mechanically prepared in a similar manner and flavoured with a little sugar and caseine. I may possibly be wrong in this conclusion, and therefore propose a test which may be used to decide this question. Let samples be made and certified by first churning pure milk, then mixing such churnings with varying proportions of foreign fats prepared as those manufacturers can, who have converted their soap-boiling into butter-frying plant, and let such samples be sent to Mr. Muter, or any other expert who believes himself able to certify to the purity or impurity of butter. If he can determine the *percentage* of foreign fat in such varied mixtures his future certificates will have considerable value and authority.

W. MATTIEU WILLIAMS

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## Science in Hastings

I HAVE just seen your comments (vol. xiii. p. 217) on a letter that appeared a few weeks ago in the Hastings and St. Leonards *News*, and at once write to vindicate the honour of Hastings. We have a Philosophical and Historical Society, a Literary and Scientific Institution, and a Mechanics' Institution, besides two or three others of a more private character. A museum we certainly do not possess, and if it should prove like most *local?* museums, a collection of "et cetera," trying to rival the British Museum in the extent of its field of research, and an overturned workbox as to arrangement, the longer we are without it the better. Far be it from me to say that the people of Hastings and St. Leonards display as much interest as they ought in the pursuit of science, but still they are not so bad as you make out. The Philosophical Society, in which I am chiefly interested, and of which I enclose last year's report, has done much good work in bygone days, but owing to a variety of circumstances it is not at present quite so flourishing as we could wish. However, I am glad to say that at the last Council meeting it was decided to publish a pamphlet containing a list of the specimens in the various branches of Natural History to be found about the neighbourhood, both on the land and in the sea. This will be but a commencement, and will be distributed among the inhabitants and visitors with a request that a notice of any alterations or additions should be sent to the Society for future publication. Thus it is hoped that fresh interest will be awakened.

My own idea is that our failure arises from a multiplicity, not a paucity of institutions, and that their aims are too high. I believe one good institution would be far better than all the separate ones. Thus we have the Literary Institution, subscription twenty-five shillings a year. This is in the old part of the town, and formerly possessed the museum and a good set of meteorological instruments. The only privileges members have are the reading room and a good standard library, which, however, has hardly been added to for some years. Next we come to the Philosophical Society, subscription 10*s*. 6*d*. a year. This certainly tries to do something, for there are papers read on various subjects, and each session concludes with a conversazione. But in my opinion its weak point is that the majority of papers read have no local bearing. I acknowledge that many display great ability, but the chief aim of such a Society should be the collection and description of subjects connected with *local* natural history, botany, climate, archæology, geology, &c., and wider researches should be left for other more suitable societies, or for special occasions now and then. The Mechanics' Institution I believe is getting on pretty well. There is a reading room, with a library, and lectures are delivered on all imaginable subjects.

If these three institutions could unite, instead of being to a certain extent antagonistic to each other, great advantage, I am sure, would accrue to the members and science generally, although none but those who have gone into the question can imagine the difficulties that would have to be overcome before a harmonious union could be effected.

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The Science and Art class to which you refer has recently been organised, and is said to be answering very well.

There is, however, a possibility that this state of things will be soon partly altered, for rumours are afloat that our excellent member, Mr. Brassey, has offered to provide a suitable building in which all the local societies will have apartments, but no particulars are yet known.

Hastings, Jan. 28 ALEX. E. MURRAY

P.S.—Since writing the above I remember that I have omitted the Athenæum, but as this is mainly a debating society it has little to do with the advance of science.

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## *OUR ASTRONOMICAL COLUMN*

THE TOTAL SOLAR ECLIPSE OF 1876, SEPT. 17–18. —The track of totality in this eclipse is wholly upon the Pacific Ocean, and in such course that only two or three small islands or reefs appear to be situate near the central line. Using the *Nautical Almanac* elements, which are almost identical with those of the American Ephemeris, wherein the moon's place is derived from Peirce's Tables, St. Matthias Island, west of Admiralty Islands off the north-east coast of New Guinea, is traversed by the central track of the shadow, with the sun at an altitude of 5° at 6h. 16m. A.M. on the 18th local time. Thence skirting Ellice Islands it passes between the Fiji's and the Samoan or Navigator group to Savage Island, in 170° west of Greenwich, latitude 19° south, which is apparently the only spot where totality may be witnessed under anything like favourable conditions, and even here the duration of totality is less than one minute. The after course of the central line does not encounter any land.

In the northern of the two large islands of the Fiji group (Vanua Levu) 179° east, a partial eclipse will occur commencing at 7h. 47m. A.M. local time 44° from the sun's north point towards the west for direct image, and ending at 10h. 16m., magnitude 0·86. In the larger island of the Navigator group, Savaii, of the Admiralty Chart, there will also be a partial eclipse, though nearly approaching totality; eclipse begins 8h. 23m. A.M. at 53° from the sun's north point towards the west, and ends at 11h. 2m., magnitude 0·97.

Assuming the north point of Savage Island to be in 169° 48′ W., with 18° 55′ south latitude, a direct calculation gives a total eclipse commencing at 10h. 8m. 6s. A.M. local mean time, and continuing 57 seconds with the sun at an altitude of 58°; the first contact of the moon with the sun's limb at 8h. 48m. A.M., 49° from his north point towards west for direct image, and the end of the eclipse at 11h. 29m.

In New Zealand the eclipse attains a magnitude of about 0·5 at Auckland, greatest phase at 9h. 18m. A.M.; towards the extremity of the southern island about Otago, one-third of the sun's diameter will be obscured about 9h. 12m. local time. A partial eclipse between similar limits will be visible on the east coast of Australia and in Van Diemen's Land.

MINOR PLANETS.—The long period of revolution assigned to No. 153, *Hilda*, by the early calculations has been confirmed by a new determination of the elements by Herr Kühnert, of Vienna, upon more than eight weeks' observations. The orbit is as follows:—

| | |
|---|---|
| Mean Longitude, 1875, Dec. 19, at Berlin noon ... ... ... ... ... ... ... | 34° 58′·7 |
| Longitude of perihelion ... ... ... ... | 285° 1′·6 |
| ,, ,, ascending node ... ... ... | 228° 20′·5 |
| Inclination to ecliptic ... ... ... ... ... | 7° 50′·9 |
| Excentricity ... ... ... ... ... ... ... | 0·16311 |
| Mean diurnal motion ... ... ... ... ... | 451″·91 |
| Semi-axis major ... ... ... ... ... ... | 3·9504 |

Hence the period of sidereal revolution is 2,868 days, or 7·85 years.—For No. 158 detected at Berlin on Jan. 4, Dr. Maywald, who has been so long occupied in computations connected with the minor planets, has proposed the name "Koronis."—No. 155, discovered by Palisa at Pola on Nov. 8, has so far been observed only on four nights, and these observations being at intervals which render them unavailable for calculation of elliptical elements, it appears not unlikely that it will be lost, as are already several minor planets similarly circumstanced, unless an effort be made to recover it with the aid of circular elements in the next period of absence of moonlight, and with some one of the larger telescopes; it was not brighter than a star of the twelfth magnitude at discovery, and must now be considerably fainter.—The period of revolution of No. 150 by seven weeks' observations is 1,879½ days.

M. Paul Henry, of the Observatory of Paris, announces his discovery of No. 159 on Jan. 26.

THE SECOND COMET OF 1702.—A complete reduction and discussion of the observations of this comet, taken at Rome by Bianchini and Maraldi, does not afford indications of elliptical motion, as might be surmised to exist from the small inclination of the orbit to the ecliptic and the direct movement. In fact, these observations appear to be by no means precise, and the differences from calculation *inter se* are too irregular to afford any hope of sensibly improving upon the orbit given by Burckhardt. Considering that the differences of right ascension between the comet and comparison stars were taken by means of clocks, and the differences of declination measured by a micrometer scale, the arc value of which was determined by observation of the sun's diameter, rather better places might have been looked for. The following are the errors given by Burckhardt's orbit, as compared with the newly reduced positions in which aberration and parallax have been taken into account:—

| | | | | |
|---|---|---|---|---|
| 1702, April 20 | Δ λ. cos. β ... | + 7′·2 | Δ β ... | − 1′·2 |
| ,, ,, 21 | ,, ... | − 1·6 | ,, ... | − 6·1 |
| ,, ,, 26 | ,, ... | − 1·4 | ,, ... | − 1·8 |
| ,, ,, 27 | ,, ... | − 3·5 | ,, ... | + 2·4 |
| ,, May 2 | ,, ... | + 9·1 | ,, ... | − 3·1 |
| ,, ,, 4 | ,, ... | − 7·6 | ,, ... | − 3·6 |

The comet was at its least distance from the earth on the night of April 19, when it approached our globe within 0·0438 of the earth's mean distance from the sun.

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## *PROF. TYNDALL ON GERMS**

IN further illustration of the dangers incurred in this field of inquiry the author refers to the excellent paper of Dr. Roberts on Biogenesis, in the "Philosophical Transactions" for 1874. Dr. Roberts fills the bulb of an ordinary pipette to about two-thirds of its capacity with the infusion to be examined. In the neck of the pipette he places a plug of dry cotton-wool. He then hermetically seals the neck and dips the bulb into boiling water or hot oil, where he permits it to remain for the requisite time. Here we have no disturbance from ebullition, and no loss by evaporation. The bulb is removed from the hot water and permitted to cool. The sealed end of the neck is then filed off, the cotton-wool alone interposing between the infusion and the atmosphere.

The arrangement is beautiful, but it has one weak point. Cotton-wool free from germs is not to be found, and the plug employed by Dr. Roberts infallibly contained them. In the gentle movement of the air to and fro as the temperature changed, or by any shock, jar, or motion to which the pipette might be subjected, we have certainly a cause sufficient to detach a germ now and then from the cotton-wool which would fall into the infusion and produce its effect. Probably, also, condensation occurred at times in the neck of the pipette; the water of condensation carrying back from the cotton-wool the seeds of life. The fact of fertilisation being so rare as Dr. Roberts found it to be is a proof of the care with which

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* On the Optical Deportment of the Atmosphere in reference to the Phenomena of Putrefaction and Infection. Abstract of a paper read before the Royal Society, January 13th, by Prof. Tyndall, F.R.S. (Communicated by the author.) Continued from p. 254.

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